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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 83



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USSR REPORT  
ELECTRONICS AND ELECTRICAL ENGINEERING  
No. 83

CONTENTS

ANTENNAS

Adaptive Method of Constructing the Image of an Object With Compensation of Phase Distortions.....	1
Interference-Immune Multiplexing Equipment for a Shortwave Receiver Antenna.....	1
Field of a Plane Aperture-Type Antenna in a Nonhomogeneous Medium.....	2
Rigorous Solution of the Problem of Excitation for a Dielectric Antenna.....	2
Calculating the Field of Aperture-Type Antennas.....	3
Iterative Method of Analyzing a Planar Antenna Array.....	3

CERTAIN ASPECTS OF PHOTOGRAPHY, MOTION PICTURES AND TELEVISION

Main Trends in Further Development of Television Broadcasting Equipment.....	5
--	---

CIRCUIT THEORY AND PRACTICE

One Version of the Method of Subcircuits for Calculation of the Characteristics of Nonlinear Electronic Circuits.....	6
Concerning Simulation of Nonlinear Electronic Circuits by the Method of Node Voltages.....	7

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND TRANSMITTERS,  
NETWORKS, RADIO PHYSICS, DATA TRANSMISSION AND PROCESSING, INFORMATION  
THEORY

Heuristical Approach to Forecasting of the Basic State Parameters of Radio Paths.....	8
Improving the Technical Operation of Communication Trunk Lines....	8
Automating the Technical Operation of a Primary Network.....	9
Feeder Circuits for Supplying Electric Power to Optical Communication Cables From Remote Sources.....	10
Effect of Vibratory Loads on the Attenuation Coefficient in Optical Cables.....	10
Splice Losses in Graded Optical Fiber Conductors.....	11
Apparatus for Measuring the Parameters of Elements of Optical Fiber Communication Lines in the Time Domain.....	11
Optical Fiber Conductors for Wideband Communication Lines (Survey).....	12
Secondary Excitation of Tropospheric Surface Waveguide by a Field of Waves Reflected From a Lifted Inversion Layer.....	13
Minimax Detection of a Random Signal With an Unknown Correlation Matrix Submerged in Background Interference With an Unknown Correlation Matrix.....	13
Exact Probability Analysis of the Conversion of Random Telegraph Signals by Adaptive Systems.....	14
Nonparametric Detectors With Ranking Relative to a Common Reference Sample.....	14
Locally Most Powerful Rank Rule of Noncoherent Signal Detection in Noises of Unknown Level.....	15
Thermodynamic Approach to the Problem of Low-Frequency Noise: Part 1.....	15
Thermodynamic Approach to the Problem of Low-Frequency Noise: Part 2.....	16
Tone-Frequency Telegraphy Equipment TT-144 DNEPR-S.....	16
Symmetric Electric Waves in Coaxial Multilayer Cylindrical Media..	17

Principles of Technical Realization of Data Transmission Systems Based on Microprocessor Assemblies of Large Integrated Circuits.....	17
Modernized ChTR-2M Multiplexing Equipment for Zonal Short-Wave Radio Communication Networks.....	18
Checking and Tuning the MT-6 Equipment.....	18
COMPONENTS AND CIRCUIT ELEMENTS, WAVEGUIDES, CAVITY RESONATORS AND FILTERS	
Electrical Strength of Air Gaps During Fluctuating Voltage Pulses.....	19
Amplification of Electromagnetic Waves in an n-GaAs Waveguide-Slot Line.....	19
CONFERENCES, SEMINARS, EXHIBITIONS, SYMPOSIUMS	
Fundamental Limitation of Overvoltages in Power Transmissions of High and Superhigh Classes of Voltage.....	21
CONVERTERS, INVERTERS, TRANSDUCERS	
Some Features in the Operation of an Inductive-Capacitive Converter With a Direct-Current Plasmatron.....	23
Tests on Electrodynamical Models of Electromechanical Frequency Converter for Flexible Coupling of Electrical Systems.....	24
Filters for Analog Information Transducers.....	24
CRYOGENICS AND SUPERCONDUCTIVITY	
Control of the Electromagnetic Field in Superconductors.....	25
ELECTRICAL ENGINEERING EQUIPMENT AND MACHINERY: APPLICATIONS AND THEORY	
Monitoring the Parameters of the Switching Circuit of Thyristor Interrupters for Traction Electric Motors.....	26
Increasing Efficiency of Ferroresonant Voltage Stabilizers.....	27
Dependence of the Weight-Size and Energy Characteristics of a Voltage Supply on the Parameters of the Discharge Circuit.....	27
Free Suspension of Cylindrical Pyrolytic Graphite Rotors in a Constant Magnetic Field.....	28

## ELECTROMAGNETIC WAVE PROPAGATION, ELECTRODYNAMICS

Electric Fields in and Characteristics of Continuous Media With a Hall Effect and With Lamellar Inclusions.....	29
Transformation of an Electromagnetic Signal Caused by a Fast Change in the Properties of the Medium.....	29
Engineering Method of Calculating the Attenuation of Millimeter Waves by Rain of Various Intensities.....	30

## ELECTRON TUBES: ELECTROVACUUM TECHNOLOGY

Thermionic Cathode With a Slotted Signal Electrode.....	31
High-Efficiency Transit-Time Klystron: Some Theoretical Problems and Experiments Pertaining to Ordered Bunching, a Nearly Convergent Bunch and Harmonics of the Convection Current.....	32
High-Efficiency Transit-Time Klystron: Some Theoretical Problems and Experiments Pertaining to Optimization of the Amplitude-Frequency Characteristic.....	32
Dependence of the Starting Current of a Backward-Wave Tube on the Entrance Angle of the Electron Beam.....	33
Dependence of the Energy Characteristics of an Orotron on the Transverse Dimensions of the Electron Beam.....	33

## ENERGY SOURCES

Concentration Dependence of the Parameters of High-Voltage Silicon-Type Solar Cells at High Illumination Intensities.....	35
---	----

## INFRARED

Use of n-InAs for Nonreciprocal Infrared Devices.....	36
---	----

## INSTRUMENTS, MEASURING DEVICES AND TESTERS, METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

Contactless Gauge for Indicating the Level of Liquid Nitrogen.....	37
--	----

## MICROELECTRONICS

Method of Calculating Polynomial Coefficients of S-Parameters of Cascade Connection of Microwave Quadripoles.....	38
---	----

POWER SYSTEMS (INCLUDING EFFECT OF VARIOUS ITEMS ON POWER TRANSMISSION)

Synthesis of Computation Methods of Accounting for Frequency Changes in Calculations of the Steady-State Regimes of Complex Electric Power Systems.....	39
Improvement of Computation Stability of Evaluation of the Condition of Electric Power Stations.....	40
Levels of Short-Circuit Currents in 220 and 500 kV Autotransformer Circuits.....	40

QUANTUM ELECTRONICS

Energy Former for Optical Range.....	42
Characteristics of Electrooptical Modulators of Laser Radiation Based on KDP Crystals.....	42

RADARS, RADIONAVIGATION AIDS, DIRECTION FINDING, GYROS

Decorrelation of the Envelope of a Radar Signal Reflected by a Target With Surface Distribution After Incidence of Signals of Various Frequencies.....	44
--	----

RECORDERS

Analysis of the Process of Magnetic Recording on a Relatively Thin Carrier by the Preisach Method.....	45
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## ANTENNAS

UDC 510.53:621.396.96

### ADAPTIVE METHOD OF CONSTRUCTING THE IMAGE OF AN OBJECT WITH COMPENSATION OF PHASE DISTORTIONS

Moscow RADIOТЕХНИКА I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 64-72  
manuscript received 19 Jul 79

RYNDIN, Yu. G.

[Abstract] Formation of the image of an object in a large-aperture radar antenna is considered with an adaptive compensation of phase distortions. The problem is defined in terms of deviation from the zero-distortion antenna characteristic and formation of a steady field distribution on the object during multiple reradiation. The adaptive compensation algorithm involves successive determinations of the parameters of bright points, assuming one bright point of unity amplitude in the steady distribution. The fidelity of a thus recovered image is approximately as high as that of one recovered by the holographic method. The algorithm was used for simulating, with the aid of a BESM-6 computer, the steady current distribution over a plane element of an object surface in a linear antenna aperture. The results indicate that such an adaptive compensation is feasible even in the case of only a few receiver-transmitter positions, and that the field distribution oscillates during the transient period of image recovery. Figures 5; references 8: 5 Russian, 3 Western (in translation).  
[231-2415]

UDC 621.396:621.22

### INTERFERENCE-IMMUNE MULTIPLEXING EQUIPMENT FOR A SHORTWAVE RECEIVER ANTENNA

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 51-58 manuscript received 17 Oct 79

MIKHAYLOV, V. S. and SHEMETOV, I. S.

[Abstract] Equipment is described which facilitates wideband signal amplification and distribution in a shortwave receiver antenna ordinarily subject to radio interference with a high spectral density over a wide energy range. Its principal components are a multiplexing amplifier and a multistep hybrid transformer-type



power splitter, with an attenuator in the input stage, and a control circuit as well as a power supply included. The multiplexer consists of a series of band filters and band amplifiers serving contiguous frequency channels so as approximately to synthesize a continuous wideband amplitude-frequency characteristic. The interference amplitude depends on the phase-frequency characteristics of these channels, but the overall dynamic range is extended so as to suppress non-linear effect such as intermodulation noise. An exact analytical determination of this increment of the dynamic range is difficult, because the relations become unwieldy as the number of channels increases, but estimates have been made on the basis of Butterworth and Chebyshev transfer functions as well as experimental data. Figures 11; tables 2; references: 8 Russian.  
[226-2415]

UDC 621.396.67

#### FIELD OF A PLANE APERTURE-TYPE ANTENNA IN A NONHOMOGENEOUS MEDIUM

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 12, Dec 80 pp 1473-1483 manuscript received 6 Dec 79

ORLOV, Yu. I. and TROPKIN, S. K., Moscow Institute of Power Engineering

[Abstract] The field of a plane aperture-type antenna in a nonhomogeneous medium is determined not only by refraction and focusing of waves but also by diffractive spreading of the wave beam. Here the field of such an antenna in a linearly nonhomogeneous half-space is analyzed according to the geometrical theory of diffraction, assuming a point source, which yields a pattern of rays and caustics. An asymptotic solution of the problem, first for a linear and then a quadratic phase excitation of the aperture, is followed by a numerical solution with the aid of a fast Fourier transformation. The basic results of this work were reported at the Seventh All-Union Symposium on Diffraction and Propagation of Waves, Rostov-On-Don, 1977. Figures 5; references 17: 15 Russian, 2 Western (1 in translation).  
[229-2415]

UDC 621.396.67.01

#### RIGOROUS SOLUTION OF THE PROBLEM OF EXCITATION FOR A DIELECTRIC ANTENNA

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 53-58 manuscript received 24 Dec 79

VASIL'YEV, Ye. N., SEDEL'NIKOVA, Z. V. and SEREGINA, A. R.

[Abstract] A model of a dielectric antenna is considered which almost exactly simulates a real antenna by including a partial shielding. The problem of electrodynamics is reduced to the excitation of a rod, a solid of revolution, by an

electric vibrator perpendicular to its axis. The problem is solved by the method of integral equations for a dielectric and an ideal conductor. Involved are the surface of the dielectric, which carries equivalent electric and magnetic currents, the surface of the metal in contact with the ambient medium and the surface of the metal in contact with the dielectric. Interaction of fields and equivalent currents at the surfaces and in the metal is taken account. A solution by the Krylov-Bogolyubov method reduces the problem to a system of linear algebraic equations. The radiation pattern is found to be produced by interference of the field of the incident surface wave and the field excited near the source, the latter determining the width of the principal lobe and the level of the side lobes, with the free end of the cylindrical antenna rod constituting an inhomogeneity with a small reflection coefficient for surface waves. Figures 4; references 7: 5 Russian, 2 Western.

[231-2415]

UDC 621.396.67.01

#### CALCULATING THE FIELD OF APERTURE-TYPE ANTENNAS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 16, No 1, Jan 81 pp 178-179  
manuscript received 12 Mar 80

FEL'D, Ya. N.

[Abstract] An antenna with a plane radiating aperture is considered and it is demonstrated that the E,H field calculated by the method of equivalent currents with given tangential components of the field vectors in the aperture will be identical to the E,H field calculated on the basis of the MacDonald model, assuming that the tangential field components in the aperture remain the same and that the aperture is surrounded by a perfectly black flange extending to infinity. The proof is based on the identical equality of the field produced by equivalent currents and the half-sum of fields produced in empty space according to the principle of mirror images. Figures 1; references 3: 2 Russian, 1 Western.

[231-2415]

UDC 621.396.667.49

#### ITERATIVE METHOD OF ANALYZING A PLANAR ANTENNA ARRAY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 46-52  
manuscript received 13 Nov 79

KHIZMALYAN, A. D.

[Abstract] An iterative method of analyzing a planar equidistant antenna array of finite dimensions is proposed which takes into account impedance coupling between elements and any number of current harmonics. The fundamental system of Kirchhoff

equations is replaced by an equivalent system of convolution equations containing two-dimensional sequences, which then through a double discrete Fourier transformation is reduced to a system of algebraic equations. The algorithm of successive approximations requires about  $NM^3 + 4NM\log_2 N$  arithmetic operations on a computer with about  $NM^2 + 3NM$  storage cells ( $N$ --number of radiators in the array,  $M$ --number of current harmonics taken into account). The algorithm is applicable to arrays with rectangular or oblique grids on a plane or even cylindrical surface. It is demonstrated here on an array of  $15 \times 15$  thin half-wave vibrators in the  $xy$ -plane, oriented parallel to the  $x$ -axis and spaced equidistantly with periods  $d_x = 0.8\lambda$  and  $d_y = 0.4\lambda$  respectively ( $\lambda$ --wavelength). Figures 3; references 7: 3 Russian, 2 Western (1 in translation).  
 [231-2415]

CERTAIN ASPECTS OF PHOTOGRAPHY,  
MOTION PICTURES AND TELEVISION

MAIN TRENDS IN FURTHER DEVELOPMENT OF TELEVISION BROADCASTING EQUIPMENT

Moscow VESTNIK SVYAZI in Russian No 12, Dec 80 pp 2-4

VARBANSKIY, A. M., chief, Main Administration of Space and Radio Communication,  
USSR Ministry of Communications

[Abstract] The nationwide television system includes more than 13,000 transmitter stations with various power ratings which broadcast over radio relays, cables, or satellites to a territory covering about 85% of the total population, thus still leaving about 15% beyond the reach of programs. Relatively simple receiver stations of the "Moskva" type with a 4 GHz wide operating frequency range are beginning to be installed alongside the more widely used receiver stations of the "Ekran" type with a 0.7 GHz wide operating frequency range. The two major objectives of further developments in television communication systems are extending the covered territory and improving the quality of service. Transmitter equipment is already in production for the 1-12th channels in the meter band (100 kW RTsTA, 50 kW "Uragan" and "Don", 5 kW "Zona-2", 5/1.5 kW ATRS) and for the 21-41st channels in the decimeter band (20 kW "Il'men'"), as well as relay equipment (1-W RPTN and 100-W RPTDA for the respective bands and 1.10/100-W RUTAN fully automatic for both bands). Also in production is receiver equipment to match those transmitters and which is suitable for reception of signals from satellites. Noteworthy new components include a precorrection of video signals developed at the Smolensk Regional Radio Television Broadcasting Center and a transistorized modulator for "Zona" transmitters developed at the Usogorsk Radio Television Broadcasting Center. At the same time, work is being done on standardizing and better organizing the operation of equipment as well as all broadcasting facilities.

[233-2415]

UDC 621.38

ONE VERSION OF THE METHOD OF SUBCIRCUITS FOR CALCULATION OF THE CHARACTERISTICS OF NONLINEAR ELECTRONIC CIRCUITS

Kiev ELEKTRONNOYE MASHELOVANIYE in Russian No 1, Jan-Feb 81 pp 74-77  
manuscript received 19 Jul 79

GODLEVSKIY, VITALIY STANISLAVOVICH, candidate of technical sciences, senior scientific-research worker, Electronics and Modelling Sector, Institute of Electrodynamics, UkrSSR Academy of Sciences, Kiev

[Abstract] This paper discusses one of the possible versions of the method of subcircuits for calculation of nonlinear circuits and the partial derivations of their dependent parameters according to the independent, which is characterized by the process of exclusion of the equations for the internal units of the subcircuits and is based on the application of the approach and methods of a 1977 work by the author. A circuit is considered in which there are  $k$  nonlinear subcircuit--multiple terminal networks. A system of nonlinear finite equations for the voltages of the principal units of this circuit is written according to Kirchhoff's first law, and a formula is obtained for its solution by the Newton method, which makes it possible at each iterative step to solve the system of subcircuit equations independently of one another. Figures 2; references:

9 Russian.  
[219-6415]

**CONCERNING SIMULATION OF NONLINEAR ELECTRONIC CIRCUITS BY THE METHOD OF NODE VOLTAGES**

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 81 pp 102-104  
manuscript received 18 Jun 79

IL'CHENKO, ALEKSANDR NIKOLAYEVICH, junior research worker, Kiev Polytechnical Institute

[Abstract] Simulation of nonlinear electronic circuits with irregular components is conducted by the method of node voltages without introduction of additional variables. The method discussed in this brief communication is based on a description of the circuit in each iteration with the aid of a system of linear nodal equations in which calculation of the irregular components is conducted in accordance with a 1977 report by V. P. Sigorskiy and E. A. Laksberg. Figures 1; references 3: 2 Russian, 1 Western.  
[219-6415]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS  
AND TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA  
TRANSMISSION AND PROCESSING, INFORMATION THEORY

UDC 518.74

HEURISTICAL APPROACH TO FORECASTING OF THE BASIC STATE PARAMETERS OF RADIO PATHS

Tashkent IZVESTIYA AKADEMII NAUK UZSSR: SERIYA TEKHNICHESKIKH NAUK in Russian  
No 6, 1980 pp 13-17 manuscript received 11 Jun 80

ALYLOVA, Z. T. and ZAKHIDOV, M. T., Uzbek Scientific-Production Association  
"Cybernetics", UzSSR Academy of Sciences

[Abstract] Heuristic methods of forecasting the state parameters of radio paths are considered. In the literature, a 1973 analysis of the principal factors which determine the quality of communication in shortwave channels shows that the majority of these factors are not subject to a strict conformity, their inter-relationship is not clear, and the most essential effects on forecasting are not manifested by them. Consequently, it is necessary to use methods based on a follow-up of past history, a search for logical conformities with respect to data concerning the process, and a description of the dynamics of the process with the aid of the most characteristic features and forecasts of the state process with respect to these features. Each of these methods is considered from the point of view of applicability to forecasting of shortwave channels. The results are presented of a forecast of the parameters of the ionosphere with respect to daily and monthly observations. A new method is proposed for forecasting the level of solar activity. Figures 1; references: 9 Russian.  
[234-6415]

UDC 621.39

IMPROVING THE TECHNICAL OPERATION OF COMMUNICATION TRUNK LINES

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 6-12 manuscript received 16 Jun 80

BEYGMAN, M. G., chief, and KILICHENKO, V. P., chief engineer, Territorial Center of Communication Trunks and Television Management TTsUMS-23

[Abstract] This article is the first of a new series which will deal with planning, development, design, manufacture, installation, operation and servicing of primary communication network equipment. Here necessary improvements in stationary cable



trunk equipment are described, including attended and unattended units, which should reduce the number and the duration of shutdowns. Since 1977 the equipment failures have already been reduced to a mere 10% of the 1967 level. Line cables and radio relay links require better protection against environmental hazards such as lightning and better prevention of mechanical or corrosive damage. Reliability of service must be further increased by providing more adequate standby capacity, especially in the area of electric power supply and switching facilities, and by raising the level of automation so as to facilitate equipment performance analysis, to streamline the operating processes, and to improve operations management. Both software and hardware are being developed for this purpose, with introduction of SM-1 small computers and microcomputers. Personnel play an essential role in advancing the state of the art and their skills and qualifications need to be improved continually by formal education and practical experience. Figures 7; references: 5 Russian.  
[226-2415]

UDC 621.39

#### AUTOMATING THE TECHNICAL OPERATION OF A PRIMARY NETWORK

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 12-15 manuscript received 16 Apr 78

BONDARENKO, V. G.

[Abstract] An automatic system of technical operations is described which should improve the technical performance of a primary network in terms of both quality and reliability within economic constraints. Implementation of this system will proceed in three stages: 1) Extension of engineering and management activities by established methods and with available equipment; 2) Generation of a data base for apparatus and instrument redesign; and 3) Introduction of new unconventional operating methods and engineering equipment. The structure of such a system for Territorial Centers of Communication Trunks and Television Management (TTsUMS) is shown which consists of seven subsystems appropriately interfaced with one another through network-service-communication channels which transmit either signals or messages, namely: network operations and control, technical service, inspection and measurements, repair and overhaul, technical operations management, administrative and engineering management, planning and accounting. The structure can be modified, and simplified, by centralization of the information processing. Each subsystem is now interfaced with the information center only and not with any other subsystem. An economic analysis of improvements thus achievable, illustrated on a typical subsystem such as centralized repair and overhaul of K-60P cable equipment, indicates that the investment recovery period will decrease to the standard goal of 8.3 years with at least  $N = 16$  sites serviced. An economic effect of over 65,000 rubles within an even shorter period should be realized with  $N = 25$  sites serviced, based on a cost of 6000 rubles for servicing one site alone. Figures 3; tables 1; references 8: 7 Russian, 1 Western in translation.  
[226-2415]

## FEEDER CIRCUITS FOR SUPPLYING ELECTRIC POWER TO OPTICAL COMMUNICATION CABLES FROM REMOTE SOURCES

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 48-50 manuscript received 21 May 80

BONDARENKO, O. V. and KORSHUNOV, V. N.

[Abstract] Feeder lines for supplying unattended regenerator stations along optical communication cables from remote electric power sources are designed so as to optimize the tradeoff between material economy and power losses, as well as reliability. The conductor materials under consideration are copper, aluminum and steel. The insulation materials available are polyethylene, fluorocarbon (Teflon) and polyvinyl chloride, a homogeneous solid system being preferred to a composite solid/air system because of the much higher electrical strength. The conductor size (diameter) will depend on the conductor material and the supply voltage as well as on the length of feeders and of cable segments between regenerators. The number of unattended regenerators supplied from a single attended one and the number of transmission cable supplied by one feeder circuit must also be taken into consideration. The insulation thickness will depend on the supply voltage and the electric field intensity at the conductor surface. Calculations based on appropriate formulas indicate that a symmetric pair of aluminum conductors 1 mm in diameter with a 0.5 mm thick solid polyethylene insulation would be the best choice for a 200-300 km long feeder line from a 2000 V supply to a 40-60 km long cable segment. Because of the strong attenuation of tone-frequency signals in such a feeder line, the latter should be utilized for low-frequency remote control only, while service telephone communication is better carried over channels in the optical system. Figures 3; tables 2.

[226-2415]

## EFFECT OF VIBRATORY LOADS ON THE ATTENUATION COEFFICIENT IN OPTICAL CABLES

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 39-41 manuscript received 21 May 80

VLASOV, A. V., INOZEMTSEV, V. P., PETRUSHKO, O. A., SAVCHENKO, V. S., SYRTSEV, A. Ye. and TSINIKIN, A. P.

[Abstract] The performance of optical fiber cables under vibratory loads was studied, the effect of microbends on the attenuation coefficient being of particular interest. Five different cable configurations were considered, including a plain insulated fiber within a protective shell, an insulated and reinforced fiber within a protective shell, and a cable also containing insulated copper conductors. Specimens of these cables were subjected to vibrations at frequencies from 50 to 5000 Hz under accelerations from 5g to 70g, while transmitting light from a GaAs laser pumped with current pulses at a 25 kHz repetition rate. The additional attenuation due to insertion losses which causes the amplitude of parasitic modulation to peak was found to increase with increasing load

acceleration and to peak sharply at frequencies depending on the cable configuration, but not to change with the cable length over the 4-16 m range, with the maximum amplitude of parasitic modulation increasing with an increasing cable length. Cables with a more compact configuration were generally found to be more stable in performance under vibrations. Further studies are needed for development of specific design recommendations. Figures 7; references: 4 Russian. [226-2415]

UDC 621.315.2:535.8

#### SPLICE LOSSES IN GRADED OPTICAL FIBER CONDUCTORS

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 46-47 manuscript received 19 May 80

MARTYNOVA, T. A.

[Abstract] A method developed earlier for calculating and minimizing the losses at splices along an optical fiber conductor with a 2-step radial profile of the refractive index is now extended to an optical fiber conductor with parabolic radial profiles of the refractive index in both the core and the shell. The refractive index is assumed to vary slowly in the core and to change by a small, not negligible, step at the core-shell boundary. The core radius is assumed to be much larger than the wavelength of the transmitted light. Calculations are based on the equation of the eigenfunction-problem in cylindrical coordinates, and numerical results obtained with the aid of a BESM-6 computer reveal the effects of small and large offsets with or without a clearance at successive splices. Figures 2; references 7: 4 Russian, 3 Western (1 in translation). [226-2415]

UDC 621.391.029.7

#### APPARATUS FOR MEASURING THE PARAMETERS OF ELEMENTS OF OPTICAL FIBER COMMUNICATION LINES IN THE TIME DOMAIN

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-TEKHNICHESKIKH NAUK  
in Russian No 1, Jan-Mar 81 pp 117-120 manuscript received 2 Jun 80

KOVALEV, I. S., LUKASHEV, V. M., VISNER, A. A. and SOLONOVICH, I. F.,  
Institute of Electronics and Institute of Applied Physics, BSSR Academy of Sciences

[Abstract] In the development and design of wideband data transmission systems with optical fiber cables it is necessary to measure the parameters of the system and of its components in the time domain as well as in the frequency domain. Apparatus has been developed for this purpose which solves some problems in the use of a solid-state laser, with modulation of the pumping current as the source of test pulse signals. The electron-optical modulator here operates in the traveling-wave mode and has a bandwidth of a few gigahertz. Also included are special pulse

shapers and standard instruments such as a spectrum analyzer and a stroboscope-type oscillograph with an analog-to-digital converter. A 1 x 1 x 40 mm crystal of lithium tantalate with a parallelism of faces within 5" and with double-layer nickel-chromium coatings on the faces perpendicular to the optical axis was placed, as an experimental electron-optical modulator, a stripline with the characteristic impedance  $Z = 50$  ohm. As active elements in the pulse shaper circuits were used charge-storage germanium diodes with a recovery time not exceeding 120 ns. Test signal pulses with a risetime of 0.3 ns and a sufficiently wide spectrum were thus generated and a 20 dB signal-to-noise ratio attained at the photoreceiver. It is also possible to switch from measurement of time characteristics to measurement of frequency characteristics by way of a discrete Fourier transformation, which has been programmed on an "Elektronika 1001" computer. The frequency characteristics of the transmission coefficient, both of magnitude and phase, of avalanche germanium photodiodes and of glass fibers have been measured by this method, as well as directly with the aid of the spectrum analyzer. Figures 4; references 6: 4 Russian, 2 Western (1 in translation). [220-2415]

UDC 621.396.22.029.7

#### OPTICAL FIBER CONDUCTORS FOR WIDEBAND COMMUNICATION LINES (SURVEY)

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 33-38 manuscript received 13 May 80

GRUDININ, A. B. and DIANOV, Ye. M.

[Abstract] The feasibility of producing optical fiber conductors with an extremely low loss coefficient of 0.2 dB/km for communication lines not requiring a closer than 100 km spacing of regenerators has already been established, but there remains the problem of signal distortion and a resulting limitation on the bandwidth. Here the mechanisms of distortion caused by the dispersive characteristics of optical fibers are analyzed on the basis of the theory of pulse widening. A 2-layer conductor is considered which consists of an inner core and an outer shell, the former having a larger refractive index, and the dependence is established of the longitudinal propagation constant on the refractive indexes of both layers and on the group phase delay which determines the conditions for single-mode or multimode transmission. Also considered are conductors with a radially graded refractive index for multimode transmission and conductors with an outer shell more dielectric than the core for filtering out the parasitic higher modes. The number of modes can be further reduced from a few to one by addition of an intermediate second shell with a refractive index smallest of all (3-layer W configuration). Simultaneous transmission of several modes with the same group velocity becomes possible upon addition of an intermediate second shell with an optical density the highest of all (3-layer ring configuration). Perfect 3-layer conductors have so far been produced in the laboratory only, by vapor-phase deposition. The authors thank A. S. Belanov, M. M. Bubnov and V. B. Nestruev for helpful comments. Figures 3; references 32: 9 Russian, 23 Western (1 in translation). [226-2415]



# SECONDARY EXCITATION OF TROPOSPHERIC SURFACE WAVEGUIDE BY A FIELD OF WAVES REFLECTED FROM A LIFTED INVERSION LAYER

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 12, Dec 80 pp 1516-1518 manuscript received 29 Jan 80

KUKUSHKIN, A. V., Institute of Radiophysics and Electronics, USSR Academy of Sciences

[Abstract] A tropospheric surface waveguide below a lifted inversion layer is considered as well as the effect of reflection of radio waves by that layer on the field in such a waveguide. Waves leaving the transmitter at the critical angle and reflected from the inversion layer excite a secondary field in the surface waveguide, in addition to the field excited in it by waves reflected from its upper wall. The intensity of such a secondary field is calculated, assuming only one reflection from the upper layer. The integral characterizing this intensity is evaluated, after the amplitude and the phase of the reflection coefficient have been expanded into a power series with the Airy function. The first term is sufficient for rough estimates made to determine the optimum heights of layers and the effects of decreasing or increasing the wavelength. The author thanks V. G. Sinitsyn for helpful comments. Figures 1; references: 2 Russian. [229-2415]

UDC 621.391

# MINIMAX DETECTION OF A RANDOM SIGNAL WITH AN UNKNOWN CORRELATION MATRIX SUBMERGED IN BACKGROUND INTERFERENCE WITH AN UNKNOWN CORRELATION MATRIX

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 92-99 manuscript received 27 Sep 79

KORADO, V. A.

[Abstract] An additive mixture of a random signal and interference is considered, both being finite discrete normal complex vector samples and each having a different unknown nondegenerate Hermitian correlation matrix. The problem of minimax detection is solved for the typical case of slowly fluctuating signals in variously staggered receiver channels. The problem is found to be invariant with respect to the group of linear transformations of the sample space. Accordingly, the minimax decision rule as well as the locally minimax and its logarithmic analog, the asymptotically minimax decision, rules are constructed on the basis of the likelihood ratio. Their efficiency is evaluated with the maximum-likelihood estimator according to Hotelling statistics as the lower-limit reference. The rules are also applicable to other cases such as an interference additionally correlated in an almost exactly known manner, a signal concentrated within a known subspace of the  $p$ -dimensional vector space, or repetitive sampling of signal and interference, independent with different unknown correlation matrixes, as well as to the real (video) analog of this detection problem. References 11: 7 Russian, 4 Western (1 in translation). [231-2415]

# EXACT PROBABILITY ANALYSIS OF THE CONVERSION OF RANDOM TELEGRAPH SIGNALS BY ADAPTIVE SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 180-183  
manuscript received 24 May 78; after revision, 12 Dec 79

BOCHKOV, G. N., DUBNOV, A. A. and MAL'TSEV, A. A.

[Abstract] Conversion of a binary Markov signal by an adaptive system of the first order is considered. The system consists of an amplifier with automatic gain control through an amplitude detector and a low-pass filter of the first order with a given time constant. An exact relation for the probability density of such a conversion is established without any constraints on the correlation time. The one-moment probability density in this case is obtained from the Kolmogorov-Feller closed integro-differential equation, only the steady-state probability distribution at time  $t \rightarrow \infty$  being of particular interest. The general result is applied to the specific example of a wideband amplifier with automatic gain control. Figures 2; references 8: 7 Russian, 1 Western in translation. [231-2415]

# NONPARAMETRIC DETECTORS WITH RANKING RELATIVE TO A COMMON REFERENCE SAMPLE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 80-86  
manuscript received 2 Jan 79

KALYUZHNYI, A. Ya. and KRASNYI, L. G.

[Abstract] Nonparametric detection with ranking of the elements of the test sample relative to a common reference sample is described. Such a ranking rather than ranking relative to individual reference samples is required when probing one-frequency pulses are spaced over a time interval too short for taking a sufficiently large number of noncorrelated reference readings. A comparative evaluation of the respective algorithms reveals that in the latter case an optimal detector synthesized on the basis of the likelihood ratio is less interference immune because of the interrelation between the rank components. An optimal detector for this case, synthesized on the basis of the minimum mean-square error, is found to offer not only a very high interference immunity, nearly the maximum attainable, but also a much simpler technical realization. Figures 3; references: 6 Russian. [231-2415]

# LOCALLY MOST POWERFUL RANK RULE OF NONCOHERENT SIGNAL DETECTION IN NOISES OF UNKNOWN LEVEL

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 87-91  
manuscript received 6 Sep 79

NIKITIN, Ya. Yu. and FILIMONOV, R. P.

[Abstract] A locally most powerful rank rule is constructed for sequential detection of a deterministic signal in noise of unknown level on the basis of two independent samples. Accordingly, the locally most powerful criterion is established for testing a composite hypothesis (Rayleigh distribution,  $\theta = 0$ ) against a composite alternative (Rice distribution,  $\theta > 0$ ) with the interference parameter  $\sigma^2$  based on the rank vector. The asymptotic relative efficiency of this rule, with a nonparametric statistic asymptotically equivalent to it, is then evaluated according to the Pitman method as well as the Bahadur method and found to be as satisfactory as that of the invariant Prokof'yev rule. Both rules ensure, furthermore, an invariant error of the first kind at any noise level and are most powerful in the important case of a low signal-to-noise ratio. References 16: 9 Russian, 7 Western (3 in translation). [231-2415]

UDC 621.391.822.3

# THERMODYNAMIC APPROACH TO THE PROBLEM OF LOW-FREQUENCY NOISE: PART 1

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 12, Dec 80 pp 1464-1469 manuscript received 8 Apr 80

VRACHEV, A. S., Moscow Institute of Power Engineering

[Abstract] A p-n junction is treated as a structure not at thermodynamic equilibrium, with only a partial (thermal) but not a configurational balance. Accordingly, the unbalance increases with heavier doping and with a wider energy gap. The kinetics of current flow through a p-n junction upon carrier injection into the base region and the relaxation process are analyzed from this standpoint, considering that nonequilibrium results in energy transfer between the lattice and the charge carriers with recombination of electron-hole pairs as the most likely consequence. Degradation of a semiconductor device to a full dynamic equilibrium is attributed not only to relaxation, with the relaxation time a quasi-logarithmic function of the aging time, but also to localization of defects in the surface layer of the space-charge region and subsequent channel formation upon current reversal, and to formation of porous brittle intermetallic compounds at the ohmic contacts as well as possibly to electrodiffusion in the metallization layer because of "electron wind". The rate of degradation depends on the capabilities of the materials and on the operating conditions, low-frequency devices having a longer life than high-frequency devices. Figures 4; references 9: 7 Russian, 2 Western. [229-2415]



## THERMODYNAMIC APPROACH TO THE PROBLEM OF LOW-FREQUENCY NOISE: PART 2

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 12, Dec 80 pp 1470-1472 manuscript received 8 Apr 80

VRACHEV, A. S., Moscow Institute of Power Engineering

[Abstract] The relation between degradation of a semiconductor device and generation of low-frequency noise is analyzed on the basis of a logarithmic distribution of relaxation times with aging, assuming that the noise spectrum has no lower cutoff frequency and only the lifetime of the device determines the limit. The rate of degradation is, furthermore, assumed to remain constant during the initial aging period. An analysis of this relation and calculations for a typical p-n junction with a shot effect indicate that low-frequency noise here is caused by conductance fluctuations during energy transfer between the excess current carriers and the crystal lattice, its intensity being proportional to the aging rate. The sharp rise of the low-frequency noise intensity preceding a failure of a device is attributed to a segregation of defects in the process of degradation. In general theoretical terms, low-frequency noise is a result of an increase of the entropy in a thermodynamically not at equilibrium. The author thanks V. N. Kuleshov and A. K. Naryshkin for helpful discussions which resulted in a better manuscript, as well as A. V. Yakimov for suggesting that this study be made. References 9: 7 Russian, 2 Western (1 in translation).

[229-2415]

## TONE-FREQUENCY TELEGRAPHY EQUIPMENT TT-144 DNEPR-S

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 81 pp 21-25 manuscript received 4 Mar 80

BUKHDRUKER, I. M., KOROP, B. V., MARTSENITSEN, S. I., SORDYGA, V. M., STEPANETS, V. A., TARBAYEV, S. I. and YAROSLAVSKIY, L. I.

[Abstract] A new telegraph equipment TT-144 has been developed which, unlike the existing TT-48 and TT-12, uses one universal type of channel subassemblies for transmission of discrete data at rates of 50 baud (24 channels), 100 baud (12 channels), 200 baud (6 channels), 1200 baud (1 channel) and 50 or 200 baud (6 or 2 channels) over the tone-frequency channel. This simplifies changing from one speed to another and shifting the signal spectrum to match a given channel, also the standby provisions and the repair operations. Quartz crystals are installed for stabilizing the performance of all components, especially the frequency modulator at the sender end and the frequency discriminator at the receiver end, as well as the switchable noninductive active RC band filters, the comparator, and the group converters. Circuit integration reduces the power drain, in addition to reducing both size and cost, while improving the reliability. Digital components are based on series K133 and K134 microcircuits, and analog components are based on series K153UD2 operational amplifiers. Also included are alarm systems,

acoustic signalization of faults in equipment and optical signalization of fadeout in reception. The performance of this TT-144 equipment exceeds ITTC specifications. The structure is functionally laid out according to the principle of individual/group conversion of signals. The equipment can be packaged in four possible ways in a  $600 \times 225 \times 2600 \text{ mm}^3$  large 3-tier bay. Figures 3; tables 2; references: 5 Russian.  
[226-2415]

UDC 621.394.73

#### SYMMETRIC ELECTRIC WAVES IN COAXIAL MULTILAYER CYLINDRICAL MEDIA

Kiev/ TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 1, Jan-Feb 81 pp 16-23  
manuscript received 14 Jun 80

TATUR, T. A. and VANSLOVA, G. A., Moscow Institute of Electronic Machine Construction

[Abstract] The filtration characteristics of coaxial multilayer cylindrical cables are considered, assuming the solid inner ideal conductor and the hollow outer ideal conductor to be separated by  $n$  isotropic shells of materials which are dielectric and paramagnetic. The propagation constant for a symmetric electric wave and the field of such a wave in a long cable of this kind are calculated from a Laplace equation with conduction and displacement currents taken into account, considering that a TEM mode cannot be excited in such a structure. The field is found not to be potential under dynamic conditions. The validity of the expressions for the propagation constant, derived from the determinant and the dispersion equation for a coaxial structure, is proved with the aid of mathematical induction. Figures 1; references 7: 6 Russian, 1 Western.  
[227-2415]

UDC 681.3.621.3

#### PRINCIPLES OF TECHNICAL REALIZATION OF DATA TRANSMISSION SYSTEMS BASED ON MICROPROCESSOR ASSEMBLIES OF LARGE INTEGRATED CIRCUITS

Tashkent IZVESTIYA AKADEMII NAUK UZSSR: SERIYA TEKHNIЧЕСКИХ НАУК in Russian No 6, 1980 pp 10-12 manuscript received 31 Mar 80

VALIYEV, M. T., Uzbek Scientific-Production Association "Cybernetics", UzSSR Academy of Sciences

[Abstract] Block diagrams are presented for three possible variations of the structure of a data transmission system based on a microprocessor. A comparative evaluation of the structures is made and the relative characteristics of the basic parameters of a microprocessor system are presented. Practical recommendations for developers of data transmission systems are given. Figures 1; references: 1 Western in translation.  
[234-6415]

## MODERNIZED ChTR-2M MULTIPLEXING EQUIPMENT FOR ZONAL SHORT-WAVE RADIO COMMUNICATION NETWORKS

Moscow VESTNIK SVYAZI in Russian No 12, Dec 80 pp 20-21

LESHCHINSKIY, N. V., chief, laboratories at the NIIR (Scientific-Research Institute of Radio)

[Abstract] Multiplexing equipment for zonal short-wave radio communication networks can be modernized through microcircuit integration, which will ensure a better performance and a higher reliability in a smaller package drawing less energy. The ChTR-2M multiplexing equipment operates with frequency multiplexing in the telephone channel and frequency manipulation in the telegraph channel. The type K533UD1 operational amplifier was selected as the basic element for its pulse shaper, detector, amplifier, resolver, and voltage stabilizer stages. The ChTR-2M consists of a transmitter part and a receiver part, the latter including two demodulators built with analog circuits, two pairs of depress and release filters, a linear full-wave detector with an active RC manipulation filter instead of the LC filter in the present version. Frequency division is provided in the manipulation channel, with a 400 Hz frequency shift, the time distortion of telegraph signals not exceeding 2% at the nominal tone signal level and 5% during a swing of the tone signal level anywhere from +10 to +45 dB. The device weighs 20 kg and is designed for operation from a  $220 \pm 33$  V - 50 Hz line, drawing not more than 25 VA without the telegraph set. Figures 1.  
[233-2415]

## CHECKING AND TUNING THE MT-6 EQUIPMENT

Moscow VESTNIK SVYAZI in Russian No 12, Dec 80 pp 29-30

STUKMAN, A. Ya., chief, laboratories at the SUR-2

[Abstract] MT-6 equipment has been designed for frequency multiplexing in communication lines or high-frequency telephone channels from studio to transmitting and receiving centers, with simultaneous operation of 6 radio-telegraph channels at rates up to 200 baud. The modem in each channel consists of a tone-frequency manipulator and a tone-frequency demodulator. Special instrumentation is available for checking and tuning these modems as well as, separately, the frequency converters and the line groups. For testing a modem, two voltage supplies, a high-frequency signal generator, and a simulator of bilateral 20 V d.c. pulses are required, and for testing a frequency converter one voltage supply and a 1680.1920 Hz manipulator. In order to test a line group one voltage supply and a frequency converter or audio oscillator are required. In each case measurements are made with an electronic-counter frequency meter and an oscillograph. Figures 3.  
[233-2415]

COMPONENTS AND CIRCUIT ELEMENTS, WAVEGUIDES,  
CAVITY RESONATORS AND FILTERS

UDC 621.315.1:621.317.333.8

ELECTRICAL STRENGTH OF AIR GAPS DURING FLUCTUATING VOLTAGE PULSES

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 pp 33-37  
manuscript received 10 Dec 70

BAZELYAN, E. M., PONIZOVSKIY, A. Z. and SLUTSKIN, L. S., Moscow

[Abstract] Electrical strength of air gaps with weakly homogeneous fields reacts to fluctuations in the voltage pulse according to the polarization of the first half-period. Negative polarization produces a much lower electrical strength in the gap than positive. Reduction of breakdown voltage may be related to negative volumetric charge introduced into the gap by a component of imperfect negative discharge. Electrical strength of multi-meter gaps with supercritical radii of curvature of the high voltage electrode may be less than in unipolar positive pulses which have a critical front. The results are presented of investigations of discharge and air gaps under the action of fluctuating voltage pulses. Figures 4; references 7: 4 Russian, 3 Western.  
[75-8617]

UDC 621.371.029.65:621.382

AMPLIFICATION OF ELECTROMAGNETIC WAVES IN AN n-GaAs WAVEGUIDE-SLOT LINE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 173-176  
manuscript received 17 Oct 79

BORISOV, V. I., BRYANTSEVA, T. A., GALANIN, A. L., GULYAYEV, Yu. V.,  
KEMARSKIY, V. A., KOROBKIN, V. A. and LYUBCHENKO, V. Ye.

[Abstract] The feasibility of amplifying electromagnetic millimeter waves in a shielded slot line is explored, such a line consisting of an n-GaAs semiconductor film on a semiinsulating GaAs substrate. The thin-film ohmic metal contacts are separated from the substrate by a semiconductor film whose electrical conductivity can vary over a wide range and become negative when the constant voltage applied to the contact strips reaches a certain magnitude. Theoretically, the conditions for amplification are established on the basis of the dispersion equation, assuming

negligible losses in the dielectric substrate and assuming a thin semiconductor structure located at the center of the waveguide cross section. The performance of such a line was experimentally studied at frequencies of 33-40 GHz, with the slot line mounted inside a standard rectangular waveguide  $7.2 \times 3.4 \text{ mm}^2$  in cross section and 1 cm long in the direction of wave propagation. The current-voltage and attenuation-voltage characteristics were measured with the aid of a klystron oscillator, a microwave pulse generator, a ferrite rectifier and a matched load. The current peaked at 150 V and the attenuation dropped sharply from 7 to 3 dB at 160 V, leaving only a stray residual attenuation in the mounting and in the contacts. The potential profile between the contacts was also measured, with a galvanometer probe, and found to depart from a linear one with increasing voltage. Figures 4; references 10: 6 Russian, 4 Western.  
[231-2415]



UDC [621.315.1.027.3:621.316.91]-0.61.3

**FUNDAMENTAL LIMITATION OF OVERVOLTAGES IN POWER TRANSMISSIONS OF HIGH AND SUPERHIGH CLASSES OF VOLTAGE**

Moscow ELEKTRICHESTVO in Russian No 1, Jan 81 pp 75-76

BOGATENKOV, I. M., KHALILOV, F. Kh. and CHERNOVA, G. V., candidates of technical sciences

[Abstract] An account is given of a Session of Section IV, "Theoretical Problems of High-Voltage Electrification", Scientific Soviet of the USSR Academy of Sciences on the complex problem "Scientific Basis of Electrification and Electric Power Engineering", held in June 1980 at Novosibirsk. Sixty representatives of 15 organizations from 6 municipalities took part in the session. Eighteen reports and communications were heard and discussed. They dealt with three basic fields: 1) Questions of deep-seated limitation of interior overvoltages in power transmissions. Reports and communications on this theme were presented by

V. Ye. Davydov, VGPI (All-Union State Planning Institute) of "Energoset'proyekt" (All-Union Order of the October Revolution State Planning and Scientific-Research Institute of Power Systems and Electric Power Networks); M. L. Levinshteyn and his coworkers, SibNII (Siberian Scientific-Research Institute of Power Engineering); V. M. Andrianov, V. V. Gusachenko, V. V. Bazutkin, MEI (Moscow Power Engineering Institute); G. A. Mamedov, AzPI (expansion unknown); N. N. Belyakov, A. N. Sherentsis, VNIIE (All-Union Scientific-Research of Electrical Power Engineering); A. K. Lokhanin, VEI (All-Union Order of Lenin and Order of the October Revolution Electrotechnical Institute imeni V. I. Lenin); K. P. Kadomskaya, NETI (Novosibirsk Electrotechnical Institute); V. I. Gavrikov, G. A. Yevdokunin, LPI (Leningrad Order of Lenin Polytechnical Institute imeni M. A. Kalinin).

2) Nonlinear Limiters of Overvoltages and the Characteristics of Their Resistors.

Reports and communications on this theme were presented by V. V. Shmatovich, V. K. Pugachev, I. M. Novitskiy, V. I. Pruzinina, V. V. Aleksandrov, VEI (All-Union Order of Lenin and Order of the October Revolution Electrotechnical Institute imeni V. I. Lenin); A. I. Shelokov, B. K. Avdayenko, V. Ye. Rozet, NPO "Elektrokeramik" (Scientific-Industrial Association "Electrical Ceramics"); S. S. Shur and his coworkers, NIPT (Scientific-Research Institute of Direct Current); M. L. Levinshteyn, SibNII (Siberian Scientific-Research Institute of Power Engineering); A. S. Torosyan, M. M. Karapetyan, Yerevan Department of the VEI (All-Union Order of Lenin and Order of the October Revolution Electrotechnical Institute imeni V. I. Lenin).

3) Conditions of Operation, Efficiency of Use and Generalization of Operating Experience of Overvoltage Limiters (OPN). Reports and communications on this theme were presented by M. V. Kostenko and his coworkers, LPI (Leningrad Order of Lenin Polytechnical Institute imeni M. A. Kalinin); V. A. F. Laslo, M. T. Nerovnyy, O. I. Yakovlev, Leningradproyekt (Leningrad Project); N. N. Tikhodeyev, S. S. Shur and others, NIIPT (Scientific-Research Institute of Direct Current); Yu. I. Lyskov, S. A. Bratslavskiy, "Energoset'proyekt" (All-Union Order of the October Revolution State Planning and Scientific-Research Institute of Power Systems and Electric Power Networks); V. M. Maksimov, Glavtekhupravleniya Minergo (Main Technical Administration on Exploitation of Power Systems, Ministry of Power and Electrification); A. K. Lokhanin, T. I. Morozova, VEI (All-Union Order of Lenin and Order of the October Revolution Electrotechnical Institute imeni V. I. Lenin); V. M. Chornogotskiy, VIT (All-Union Scientific-Research Planning and Design and Technological Institute of Transformer Building).

Participants in the session noted the large contribution introduced by the Leningrad Department of "Gidroproyekt" (All-Union Order of Lenin Planning, Surveying and Scientific-Research Institute imeni S. Ya. Zhuk) in placing non-linear limiters into the practice of power construction. Eight problems in the field of stringent limitation of overvoltages are listed which the Session considered must be further investigated.

[235-6415]



## CONVERTERS, INVERTERS, TRANSDUCERS

UDC 621.314.572

### SOME FEATURES IN THE OPERATION OF AN INDUCTIVE-CAPACITIVE CONVERTER WITH A DIRECT-CURRENT PLASMATRON

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 1, Jan-Feb 81 pp 53-58  
manuscript received 21 Feb 80

PETROV, S. V., Institute of Natural Gas, UkSSR Academy of Sciences

[Abstract] Equipment for deposition of protective coatings in an atmosphere of the plasma of the combustion products of natural gas has been developed jointly by the Institutes of Natural Gas and of Electrodynamics at the UkSSR Academy of Sciences. It includes a plasmatron supplied through a dry-type 100 kVA 3-phase 380/220 V transformer with a Larionov rectifier in the voltage channel and two 3-phase inductive-capacitive converters in parallel in the current channel. One converter in the form of a T-circuit with interphase coupling is not controllable. One converter in the form of a 3-phase induction motor with a blocked rotor and with a 3-phase capacitor bank across the stator can be regulated by rotation of the rotor. The rectifier in the current channel is followed by an adjustable smoothing choke filter. The plasmatron has a total capacity of 200 kW, of which 40 kW is delivered by the gas and 160 kW is delivered by Joule-effect heating in the arc. Its current-voltage characteristics, dependent on the flow rate of the plasma forming mixture and on the excess oxidizer, have been measured. Current and voltage waveforms have been analyzed, taking into account energy balance as well as amplitude modulation and phase shifts. Figures 5; references: 3 Russian. [227-2415]

# TESTS ON ELECTRODYNAMIC MODELS OF ELECTROMECHANICAL FREQUENCY CONVERTER FOR FLEXIBLE COUPLING OF ELECTRICAL SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 pp 47-50  
manuscript received 27 Sep 79

BLOTSKIY, N. N., BRONSHTEYN, E. L., DASHEYEV, S. O., MAMIKONYANTS, L. G.,  
TEMIZHEV, M. E., TSGOYEV, R. S. and SHAKARYAN, Yu. G.

[Abstract] Electromechanical frequency converters (EMFCh) consist of two alternating-current machines whose shafts are mechanically interconnected and whose stator windings are connected to a coupler. This paper presents the results of experimental investigations of AC electromechanical frequency converters. The investigations had as their principal goal to finish and decide upon a control algorithm for these converters. The tests were made on an electrodynamic model at the BNIIE (All-Union Scientific-Research Institute of Electrical Energy). A number of organizations are listed which are concerned with complex scientific-research work on determining the properties and prospective use of AC electromechanical frequency converters. Figures 5; references: 4 Russian.  
[75-8617]

UDC 621.317.71.084.2.035.82

# FILTERS FOR ANALOG INFORMATION TRANSDUCERS

Moscow ELEKTRICHESTVO in Russian No 1, Jan 81 pp 70-72  
manuscript received 24 Jul 79

BOGACHKOV, M. L. and KICHAYEV, V. V., Leningrad

[Abstract] Realization of low-frequency filters with specified amplitude--frequency characteristics, conducted on the basis of approximating polynomials, leads to polynomial filters, of which the widest dissemination is obtained by Butterworth and Chebyshev filters. In the present paper, the choice is considered of such filters to be used in analog information transducers. It is shown that the interval of establishment of a transient process, by which is understood the time of entry of the output coordinates of a filter into the vicinity of the equilibrium position, is smaller for filters approximated according to Butterworth. Entry into a transfer function of nulls, corresponding to the frequencies of subharmonics, with the exception of the basic problem of suppression of these subharmonics, improves the quality of the transient process. On the basis of an analysis of the time and frequency properties of low-frequency polynomial filters, it is possible to assert that in the transducers of information systems or control systems where a minimum time of information take-off is important, it is advisable to use a Butterworth filter with null at the frequency of the subharmonics. Figures 1; tables 2; references: 3 Russian.  
[235-6415]

UDC 537.312.62:621.3.013.001.24

CONTROL OF THE ELECTROMAGNETIC FIELD IN SUPERCONDUCTORS

Moscow ELEKTRICHESTVO in Russian No 1, Jan 81 pp 51-55  
manuscript received 11 Aug 80

LUTIDZE, Sh. I., doctor of technical sciences, Moscow

[Abstract] A microscopic nonlocal theory of superconductors is proposed which is in conformity with the various microscopic properties of superconductors listed in this paper. The theory makes possible a quantitative analysis of the magnitudes connected with these microscopic properties, and also (as a particular case) determination of known expressions for models of the critical state of superconductors. Superconductors are considered as a diamagnetic conducting medium with nonlocal properties. The nonlocality of the superconducting medium consists of the fact that the field intensity and magnetization at points within the superconductor depend not only on the magnetic induction at the point considered (as this occurs in linear, isotropic and nonlinear media) but also on the magnetic induction at the surface, located close to these points. Determination of the electromagnetic field in superconductors reduces to a Dirichlet boundary value problem. According to the proposed theory, in addition to the specified end values of the magnetic field induction, it is necessary at the surface of a superconductor to determine the coefficient of nonlocalization of the magnetic field. Expressions are obtained for the characteristic of nonlocalization of the magnetic field and the effective values of the magnetic susceptibility and resistivity of a superconductor, as well as an analytical approximation of these magnitudes. These expressions satisfactorily describe the properties of a superconducting medium and are suitable for conducting engineering calculations. Figures 2; references 5: 1 Russian, 4 Western in translation.  
[176-6415]

ELECTRICAL ENGINEERING EQUIPMENT AND  
MACHINERY: APPLICATIONS AND THEORY

UDC [621.316.52:621.33].004.5

MONITORING THE PARAMETERS OF THE SWITCHING CIRCUIT OF THYRISTOR INTERRUPTERS  
FOR TRACTION ELECTRIC MOTORS

Moscow ELEKTRICHESTVO in Russian No 1, Jan 81 pp 59-61

KHOMENKO, A. I. and RYABTSEV, G. G., candidates of technical sciences,  
MIIT [Moscow Order of Lenin and Order of Red Banner of Labor Institute of  
Railroad Transport Engineers]

[Abstract] Realization of a prospective system for the thyristor interrupters of traction electric motors requires monitoring of the combined interrupter elements which can change in the course of time. Straightforward measurement of these parameters directly in the circuit of an interrupter is impossible because of the presence of shunting circuits. In as much as such a measurement is impossible, then one is obliged to disassemble the circuit of the interrupter. In addition, such measurements do not give a sufficiently complete pattern because they do not take into consideration the mutual effect of the combined elements of the interrupter in the overall circuit. The present paper proposes an indirect method for measurement of the parameters of the switching circuit of a thyristor interrupter by the parameters of the electrical signals which are found in this circuit during pulse operation of the interrupter. The circuit of the thyristor interrupter and time diagrams of the voltage and current in its switching circuit are shown, as well as graphs of the dependence of the relative changes of the monitored magnitudes on the change of capacitance, induction and the effective resistance of the switching circuit of the interrupter. Figures 2.

[235-6415]

## INCREASING EFFICIENCY OF FERRORESONANT VOLTAGE STABILIZERS

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 pp 21-25  
 manuscript received 20 Dec 78

BAL'YAN, R. Kh., doctor of technical sciences, and ROSHAL', M. I., candidate of technical sciences

[Abstract] Simplicity, reliability and low cost of ferroresonant voltage stabilizers (FSN) are important attractions, inspite of magnetic amplifiers and semiconductor stabilizers. The basic circuitry of the most common FSN has a parallel ferroresonance loop and remote linear inductance coil. Input voltage fluctuations are compensated by changing the voltage in the linear choke coil. Efficiency should be at least 80% of that measured in the prototype models. The present paper shows that use of a phase control regime makes it possible to create effective and economical ferroresonant voltage stabilizers, free from the shortcomings characteristic of ordinary ferroresonant voltage stabilizers. Figures 3; references: 3 Russian.  
 [75-8617]

## DEPENDENCE OF THE WEIGHT-SIZE AND ENERGY CHARACTERISTICS OF A VOLTAGE SUPPLY ON THE PARAMETERS OF THE DISCHARGE CIRCUIT

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 1, Jan-Feb 81 pp 103-106  
 manuscript received 18 Dec 79

MUZAFAROV, R. M., KOFMAN, D. B. and KOVAN, Yu. I., Moscow Institute of Aviation

[Abstract] Voltage supplies for aircraft must be designed with minimum weight and maximum efficiency. The latter is determined by the charging capacitor as well as by the discharge circuit. Here the performance is analyzed of both charge and discharge circuits during simultaneous operation. Relations are derived for the ratio of initial-to-final voltage across the charging capacitor, for the maximum charging current, and for the ratio of output power to input power--all as functions of the capacitance, the load resistance and the discharge period. These relations, presented in graphical form on the basis of specific numerical catalog data, can be used for optimum design of a voltage supply. Figures 3; references: 1 Russian.  
 [227-2415]

## FREE SUSPENSION OF CYLINDRICAL PYROLYTIC GRAPHITE ROTORS IN A CONSTANT MAGNETIC FIELD

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 1, Jan-Feb 81 pp 106-107  
manuscript received 12 Nov 79

PONIZOVSKIY, V. M., Perm' State University

[Abstract] The possibility of free suspension of diamagnetic bodies in a constant magnetic field has already been proved. Here the general force relations are applied to cylinders made of pyrolytic graphite (density  $2.3 \cdot 10^7 \text{ kg/m}^3$ ). Successful experiments were performed with cylindrical rotors weighing up to 5.3 g in the magnetic field produced by an electromagnet with pole shoes made of Armco iron. The best results were obtained with a rotor weighing 3.45 g and having an outside diameter of 29.3 mm. It was freely suspended in a magnetic field of 0.85 T strength in the interpolar gap, requiring a power of 3.0 W. In a magnetic field of 1.8 T strength, with a power of 50 W, it could carry a load of 11.5 g. In a magnetic field of 2.1 T strength, with a power of 1200 W, it could carry a load of 20 g. Permanent magnets made of YuNDK25BA and YuNDK35T5 alloys or of the samarium-cobalt intermetallic compound  $\text{SmCo}_5$  are also suitable for this purpose and can be used for freely suspending graphite rotors in various instruments. Figures 2; references 4: 1 Russian, 3 Western (2 German).  
[227-2415]



## ELECTROMAGNETIC WAVE PROPAGATION, ELECTRODYNAMICS

UDC 537.311.33

### ELECTRIC FIELDS IN AND CHARACTERISTICS OF CONTINUOUS MEDIA WITH A HALL EFFECT AND WITH LAMELLAR INCLUSIONS

Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 1, Jan-Feb 81 pp 9-16  
manuscript received 13 May 80

GORODZHA, L. V. and YEMETS, Yu. P., Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev

[Abstract] Continuous media with a Hall effect are considered which contain separate lamellar inclusions identically oriented relative to one another in a direction either parallel or normal to the magnetic field. The solution to the electrodynamic problem is obtained for the extreme cases of dielectric inclusions with a zero electrical conductivity and ideally conducting inclusions with an electrical conductivity much higher than that of the matrix material. With sufficiently long inclusions the electric field is regarded as a two-dimensional one. Expressions for the conductivity tensor are derived on this bases, and the concentration of inclusions and its product by the Hall coefficient of the matrix are found to be the two parameters which characterize the effective electrical conductivity in a strong magnetic field. Figures 3; references 10: 8 Russian, 2 Western.  
[227-2415]

UDC 538.56:538.311

### TRANSFORMATION OF AN ELECTROMAGNETIC SIGNAL CAUSED BY A FAST CHANGE IN THE PROPERTIES OF THE MEDIUM

Gor'kiy *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA* in Russian Vol 23, No 12, Dec 80 pp 1495-1506 manuscript received 2 Jul 79

BORISOV, V. V., Leningrad State University

[Abstract] Concerning the behavior of an electromagnetic field in a medium whose properties vary with time, the transformation of the component field vectors caused by an instantaneous change of these properties is considered in the case of a medium which at  $t = 0$  changes from a nondispersive one to a dispersive plasma.



An exact solution is obtained for the Maxwell field equations (two equations in  $E_y, B_z, v_y$ ) for a signal describable by the Heaviside function as it enters such a plasma, the plasma assumed to be collisionless in the linear approximation. Both transient and steady state are included in the solution, also in calculations for a signal which was sinusoidal before the step change. References 11: 7 Russian, 4 Western (2 in translation). [229-2415]

UDC 621.371.029.65

# ENGINEERING METHOD OF CALCULATING THE ATTENUATION OF MILLIMETER WAVES BY RAIN OF VARIOUS INTENSITIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 59-63  
manuscript received 29 Jan 80

MALINKIN, V. G.

[Abstract] Absorption of millimeter waves in precipitates such as raindrops is analyzed on the basis of fundamental theoretical relations as well as experimental data which have been evaluated by the method of least squares with the use of regression equations. As a result, a simple and quite accurate engineering formula is obtained for the attenuation coefficient  $\gamma(\text{dB/km})$  as a function of the wavelength and the rain intensity

$$\gamma(J, \lambda) = k(\lambda)J^{n(\lambda)}$$

where  $k(\lambda) = a_0 + a_1\lambda + a_2\lambda^2$  and  $n(\lambda) = b_0 + b_1\lambda + b_2\lambda^2$ . The constants have been evaluated from data pertaining to  $1 \leq \lambda \leq 10$  mm wavelengths and  $J = 1-100$  mm/h rain intensities at  $t = 20^\circ\text{C}$ , taking into account the refractive index of water in accordance with the Debye theory and the Marshall-Palmer distribution. The author thanks M. A. Kolosov, A. V. Sokolov and A. Yu. Zrazhevskiy for steady interest as well as for helpful suggestions and discussion of the results. Figures 1; references 50: 16 Russian, 34 Western. [231-2415]

UDC 621.3.032.213:621.3.049.77

THERMIONIC CATHODE WITH A SLOTTED SIGNAL ELECTRODE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 196-198  
manuscript received 3 May 79

PETROV, Ye. N.

[Abstract] In order to evaluate the performance of a thermionic cathode and a slotted signal electrode in miniature vacuum-tube devices, it is necessary to take into account the effect of drift on the emission capacity of the cathode and the effect of a nonuniform current density over the cathode surface. These effects were studied on two variants of a device with the cathode base activated by a coating of barium oxide (work function 1.3 eV) and with a 15 micrometer thick grid electrode. In the first variant the grid was 35 micrometer away from the cathode surface, with a 110 micrometer distance from cathode to anode. In the second variant the grid was 28 micrometer away from the cathode surface, with an 83 micrometer distance from cathode to anode. The distribution of the current density over the cathode surface was measured at an anode voltage of 30 V and three different grid voltages (-1, -2, -3 V), and then plotted in fractions of a  $1 \text{ A/cm}^2 = 100\%$  saturation current density at the active spot at 1000 K. An evaluation of the utilization of active surfaces on the basis of these readings indicates that a closer spacing of the electrodes did not yield the desired result, inasmuch as a slightly larger utilization factor is accompanied by a current density at the oxide surface higher than the classical permissible  $0.25 \text{ A/cm}^2$  upper limit. The author thanks I. L. Grigorishin for helpful comments. Figures 2; references 9: 8 Russian, 1 Western.  
[231-2415]

# HIGH-EFFICIENCY TRANSIT-TIME KLYSTRON: SOME THEORETICAL PROBLEMS AND EXPERIMENTS PERTAINING TO ORDERED BUNCHING, A NEARLY CONVERGENT BUNCH AND HARMONICS OF THE CONVECTION CURRENT

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 139-145  
manuscript received 19 Nov 79

KOCHETOVA, V. A., KUCHUGURNYY, V. I., LEBEDINSKIY, S. V., MALYKHIN, A. V. and PETROV, D. M.

[Abstract] A 7-cavity television klystron with a second-harmonic resonator as the fourth cavity is considered and the conditions of optimum bunching are determined which make an 80% efficient energy extraction feasible. An analysis of the "fine" structure of the electron beam at three points on the optimum amplitude-frequency characteristic, based on theoretical calculations and experimental data, indicates that ordered bunching of the electron beam by the microwave fields in the signal-frequency cavities and in the second-harmonic cavity can produce a relatively wide convergent bunch in the catcher. Its characteristics are determined not by the amplitudes of the first and second harmonics, which may differ appreciably, but by the electron density and velocity distributions. The efficiency and the trend of the amplitude-frequency characteristic are very sensitive to changes of the second-harmonic frequency. Lowering the latter reduces the maximum efficiency and increases the bandwidth, while a sufficiently large mismatch renders the second-harmonic resonator ineffective so that the device becomes a plain 6-cavity klystron. Figures 6; references: 4 Russian.  
[231-2415]

# HIGH-EFFICIENCY TRANSIT-TIME KLYSTRON: SOME THEORETICAL PROBLEMS AND EXPERIMENTS PERTAINING TO OPTIMIZATION OF THE AMPLITUDE-FREQUENCY CHARACTERISTIC

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 132-138  
manuscript received 19 Nov 79

KOCHETOVA, V. A., KUCHUGURNYY, V. I., LEBEDINSKIY, S. V., MALYKHIN, A. V. and PETROV, D. M.

[Abstract] A high-efficiency multicavity television klystron with a second-harmonic resonator is considered, such a device requiring not only a "one-dimensional" and nearly "laminar" uniform electron beam but also an ordered bunching with the optimum velocity distribution at the catcher entrance. An experimental evaluation of two such klystrons, a 9-cavity one and a 6-cavity one with single-gap resonators each, confirms theoretical calculations of the amplitude-frequency characteristics and indicates the feasibility of a 70-80% efficient energy extraction with a second-harmonic resonator added behind the third cavity in the 6-cavity device but not with two cavities of the 9-cavity device excitable at the second-harmonic frequency. Figures 5; references 10: 9 Russian, 1 Western.  
[231-2415]

## DEPENDENCE OF THE STARTING CURRENT OF A BACKWARD-WAVE TUBE ON THE ENTRANCE ANGLE OF THE ELECTRON BEAM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 127-131  
manuscript received 3 May 79

KIRICHENKO, A. Ya. and SOLODOVNIK, V. A.

[Abstract] An O-type backward-wave tube is considered with an electron beam moving along helical trajectories and with the vector of the high-frequency electric field in the plane of the retarding system. The energy transfer between an electron and the surface field of the traveling wave is calculated, assuming that they move in synchronism, and the effect of varying the angle at which the electron beam enters the interaction space is evaluated in terms of efficiency. The results of experiments made with an electron ribbon beam produced by a diode-type electron-optical system and with four variants of a retarding comb structure reveal an orthoclinotropic effect. At some entrance angle other than zero the starting current is minimum and thus the efficiency is maximum, while at some slightly different entrance angle the output power is maximum. Changing the direction of the magnetic field away from the comb lead angle will increase the minimum starting current and the corresponding to it entrance angle. Figures 4; tables 1; references: 5 Russian.  
[231-2415]

UDC 621.385.6.001

## DEPENDENCE OF THE ENERGY CHARACTERISTICS OF AN OROTRON ON THE TRANSVERSE DIMENSIONS OF THE ELECTRON BEAM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 155-161  
manuscript received 18 Dec 79

BELYAVSKIY, B. A., TSEYTLIN, M. B. and BERNASHEVSKIY, G. A.

[Abstract] The performance of an orotron is calculated taking into account the nonuniform distribution of the high-frequency electric field over the cross section of the electron beam. The magnetic focusing field is assumed to be sufficiently strong to prevent transverse motion of electrons under dynamic conditions. The intensity of the Gaussian high-frequency field in the open resonator cavity with spherical mirrors is assumed to taper exponentially with increasing distance from the reflecting grid. Then the expression for the longitudinal component of the space harmonic of this field interacting with the electron beam and the equation of electron motion, assuming a negligible space charge, yield the electron efficiency as a function of the beam width and thickness. Increasing one

dimension of the beam is found to decrease the effect of the field nonuniformity along the other dimension. The starting current, calculated for small amplitudes of the high-frequency field by equating the power transferred from the electron beam to the power loss in the resonator cavity, decreases with decreasing beam width and, when the gap between the beam and the reflecting grid is held constant, with decreasing beam thickness. Figures 4; references: 5 Russian. [231-2415]

UDC 629.7.064.54:621.382

CONCENTRATION DEPENDENCE OF THE PARAMETERS OF HIGH-VOLTAGE SILICON-TYPE SOLAR CELLS AT HIGH ILLUMINATION INTENSITIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 190-194  
manuscript received 3 Oct 77

GALKIN, G. N., YEVDOKIMOV, V. M., KOVAL', O. I., KUDESHOVA, L. P.,  
MILOVANOV, A. P., STREBKOV, D. S. and UNISHKOV, V. A.

[Abstract] Operation of solar cells at high illumination intensities requires silicon p-n junctions with a low electrical volume resistance of the base region. Increasing the impurity concentration results in a larger emf, but it also decreases the mobility and the lifetime of minority charge carriers so that the photocurrent and the output power decrease. There must be some optimum impurity level, therefore, which will vary depending on the illumination intensity. An experimental study was made of silicon-type solar cells designed for high voltage and high illumination intensity. Four  $5 \times 5 \times 1 \text{ mm}^3$  specimens with an electrical resistivity of 0.01, 0.1, 1.0 and 7.5 ohm.cm, respectively, were tested under illumination over the 0.01-3.5 kW/cm<sup>2</sup> range. The length of the diffusion path for minority carriers was determined and found to change from 100 micrometer in weakly doped silicon (7.5 ohm.cm) to 8.5 micrometer in strongly doped silicon (0.01 ohm.cm). Also measured were the emf and the shortcircuit current as well as the entire current-voltage characteristic and the output parameters. Maximum efficiency under an illumination equivalent to one sun (1340 W/m<sup>2</sup>) was obtained with the  $\rho = 1.0 \text{ ohm.cm}$  cell, maximum output power of 21 W/cm<sup>2</sup> under an illumination of 3500 W/m<sup>2</sup> was obtained with the  $\rho = 0.1 \text{ ohm.cm}$  cell. This power density is 100 times higher than the maximum attainable with conventional solar cells. Figures 5; tables 2; references: 5 Russian.  
[231-2415]



## INFRARED

UDC 621.372.832.029.73:621.382

### USE OF n-InAs FOR NONRECIPROCAL INFRARED DEVICES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 p 204  
manuscript received 19 Nov 79

USANOV, D. A., VAGARIN, A. Yu. and VENIG, S. B.

[Abstract] Faraday-effect rotators built with indium antimonide are unsatisfactory in the infrared range, because of the large reflection and absorption coefficients. A study was made in order to determine the feasibility of using indium arsenide, with a higher mobility of charge carriers and better temperature characteristics, as the material for such a device. Specimens of indium arsenide with an electron concentration of  $2.8 \cdot 10^{16} \text{ cm}^{-3}$  were placed between the poles of a magnet with holes for passing a laser beam and a Brewster polarizer in the path of that beam. An OKG-15 laser was used in the experiment. With a  $45^\circ$  angle between the directions of polarization in the arms, the dependence of the insertion losses and of the decoupling between the rotator arms on the magnetic field intensity and on the thickness of the InAs material was measured at room temperature. A decoupling as high as 11 dB with an insertion loss as low as 0.1 dB were attained using a 2 mm thick specimen of n-InAs. Figures 2; references: 1 Western.  
[231-2415]

INSTRUMENTS, MEASURING DEVICES AND TESTERS,  
METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

CONTACTLESS GAUGE FOR INDICATING THE LEVEL OF LIQUID NITROGEN

Moscow VESTNIK SVYAZI in Russian No 12, Dec 80 p 28

IVERSHIN, N. I., chief, workshop at the Kemerovo Regional Radio Television Broadcasting Center

[Abstract] Parametric low-noise amplifiers in "Orbita" space communication stations are cooled with liquid nitrogen. Reliable operation of these amplifiers depends on maintenance of the liquid level in the Dewar flasks. In order to eliminate contacts, which become inflexible at  $-196^{\circ}\text{C}$ , a contactless level gauge has been developed which consists of three resistive probes. At normal level a current of 300 mA flows in each resistance and produces a voltage drop which, through a transistor switch, lights an indicator lamp. As the liquid level drops below normal, the resistor heats up and the current through it decreases so that the voltage drop decreases and the lamp goes out. The gauge is energized from a 6.3 V a.c. source through a bridge rectifier. The resistance wires (0.05 mm copper wire with vinyl enamel insulation) are wound on Teflon bobbins. The nominal resistance is approximately 100 ohm. The probes are hermetically enclosed. Figures 4.

[233-2415]

UDC 621.372.011.71

METHOD OF CALCULATING POLYNOMIAL COEFFICIENTS OF S-PARAMETERS OF CASCADE CONNECTION OF MICROWAVE QUADRIPOLES

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 81 pp 91-93  
manuscript received 6 Jun 79

KARPUKOV, LEONID MATVEYEVICH, candidate of technical sciences, senior instructor, Zaporozhskiy Machine Building Institute

[Abstract] During the solution of problems of analysis and synthesis of microwave devices the necessity often arises for finding their network functions in the form of the dependences of S-parameters on the complex frequency  $p$ . As is known, the process of finding coefficients from which the numerator and denominator of the network functions are formed reduces to expansion of the minors of the matrix of the equivalent parameters of the network in question. The present short communication describes a simple method for solving this problem, which arises during calculation of the S-parameters of a microwave network thought of as a cascade connection of quadripoles. In contrast to known algorithms, the proposed method makes it possible during calculations of the network functions of microwave cascade circuits to replace existing complex procedures for expansion of minors by the less time-consuming operation of multiplication of matrixes and thereby to increase the effectiveness of calculations. Figures 1; references: 3 Russian. [219-6415]

POWER SYSTEMS (INCLUDING EFFECT OF  
VARIOUS ITEMS ON POWER TRANSMISSION)

UDC 621.311.1:518.5

SYNTHESIS OF COMPUTATION METHODS OF ACCOUNTING FOR FREQUENCY CHANGES IN  
CALCULATIONS OF THE STEADY-STATE REGIMES OF COMPLEX ELECTRIC POWER SYSTEMS

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 81 pp 67-74  
manuscript received 23 Jun 80

GREB, AVGUST AVGUSTOVICH, junior research worker, and  
MAKAROV, VYACHESLAV MIKHAYLOVICH, candidate of technical sciences, scientific  
secretary, Siberian Scientific-Research Power Institute, Novosibirsk

[Abstract] The dependence of supervisor control of the operation of power systems on a change of frequency in the system is considered, the economical operation of which is attained by the adoption of a rated value of the frequency (50Hz in the USSR) with a rigorous limitation on the permissible duration:  $\pm 0.2\%$ . On the other hand, if the duration of steady-state regimes with a significant deviation of frequency can reach 10s of minutes, then it is obvious that knowledge of such regimes and their calculations is of significant value. Systemization of existing methods and synthesis of new methods for calculation of steady-state regimes of complex electric power systems are described in the present paper with a change of frequency taken into account. The method of approach described for synthesis of computation methods can be used (with suitable modifications, not infringing upon the methodological nature of the material stated in the paper) for a solution of nonlinear equations of general form, in particular to systems of control of a steady-state regime without change of frequency taken into account. Figures 1; references 15: 13 Russian, 2 Western (1 in translation).  
[219-6415]

## IMPROVEMENT OF COMPUTATION STABILITY OF EVALUATION OF THE CONDITION OF ELECTRIC POWER STATIONS

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 81 pp 78-80  
manuscript received 30 May 80

CHERNENKO, PAVEL ALEKSEYEVICH, candidate of technical sciences, senior scientific-research worker, and PRIKHNO, VITALIY LEONIDOVICH, graduate student, Institute of Electrodynamics, UkSSR Academy of Sciences

[Abstract] During evaluation of the condition of electric power systems an over-determined system of nonlinear equations is obtained, which is ordinarily solved by the method of weighted least square (MWLS). The use of MWLS involves smoothing of the errors of measurement. Shortcomings of a computational nature are inherent in this method. The algorithms based on the Holessky expansions and the Lantsosh method presented and described in the present paper make it possible to improve the precision of the MWLS and the stability of calculations during evaluation of the state of electric power stations. Figures 1; tables 2; references 8: 7 Russian, 1 Western in translation.  
[219-6415]

## LEVELS OF SHORT-CIRCUIT CURRENTS IN 220 AND 500 kV AUTOTRANSFORMER CIRCUITS

Moscow ELEKTRICHESTVO in Russian No 1, Jan 81 pp 63-68  
manuscript received 11 Sep 80

BOGOMOLOV, V. S., engineer, L'VOV, Yu. N. and KOKHAN, P. G., candidates of technical sciences

[Abstract] A study by the method of mathematical modeling is made of the statistical distribution of the maximum levels of short-circuit currents for autotransformers with a highest voltage of 220 and 500 kV. The study covers the entire lifetime of a transformer, i. e., approximately 25 years. The levels of short-circuit currents were determined, not in the same windings, but at the transformer outputs, i. e., in circuits external with respect to the windings. An investigation is made of the function  $F_n(k)$  of the cumulative rate of the observed series of the distribution levels in a succession of  $n$  220 and 500 kV autotransformers during their operation in 3- and 2-winding regimes with the values taken into account of the short-circuit voltage on the basis of the distributing mains for circuits of high, middle and low voltage with 3-phase and 1-phase short circuits for the individual stages of development of the integrated power systems (OES). For a study of the dynamics of the change of the levels of short-circuit currents, the values of the functions  $F_n(k)$  were constructed for the years encompassing the period 1965-1975, the present moment and prospects up to 1985-1990, in accordance

with data obtained by "Energoset'proyekt" (All-Union Order of the October Revolution State Planning and Scientific-Research Institute of Power Systems and Electric Power Networks) and its units while working out of circuits for development of power systems. The circuits of the by far the largest OES of the USSR, with an overall number of 439 autotransformers observed of the 220 and 500 kV class, were submitted to the analysis. As an example, the values of the function  $F_n(k)$  are shown for 4 stages of development of one of the power systems with a 500 kV voltage, for 1975, 1980, 1985 and 1990. It is shown that the partial set of the levels of short-circuit currents for the individual stages of growth of networks belongs to one and the same normal distribution of the overall set. A method is proposed for determining the required maximum values of the levels of short-circuit currents. Figures 1; tables 1; references: 9 Russian.  
[235-6415]



UDC 621.373.826.722.99

ENERGY FORMER FOR OPTICAL RANGE

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 81 pp 93-95  
manuscript received 20 Jun 80

ZYUBRIK, ALEKSEY IVANOVICH, candidate of technical sciences, L'vov

[Abstract] Precise control of the magnitude of the energy of exposure is of great value during the development and investigation of photothermoplastic media, applicable to devices for operational recording, readout and erasure of holographic information. The present brief communication describes a comparatively simple energy former with a wide dynamic range of the energy unit, a block diagram of which is shown. The former was successfully investigated in a general-purpose holographic circuit in order to study the contrast-frequency and exposure characteristics of photothermoplastic carriers, during which a high precision (error not more than 0.5%) wide range ( $10^{-3} \div 10^4$  Joule) of energy exposure, reliability and convenience in operation was observed. The former described may also be used in a "timer" mode. For this a reference voltage is fed to the input of the converter, as the result of which time-marks are formed at the output. Constructively, the former has the appearance of a portable instrument in the unified housing "Rapid-1" with dimensions of 360 x 415 x 120 mm. Figures 1; references: 1 Russian.  
[219-6415]

UDC 621.376.9

CHARACTERISTICS OF ELECTROOPTICAL MODULATORS OF LASER RADIATION BASED ON KDP CRYSTALS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 1, Jan 81 pp 16-21 manuscript received 14 Jan 80

MODULINA, A. N. and NOVOGRODSEV, A. B.

[Abstract] Crystals of such substances as KDP (potassium dihydrogen phosphate), with a refractive index dependent on the electric field intensity, are used as

modulators of laser radiation. Here a cylindrical modulator crystal with electrodes of finite width contacting its lateral surface is considered, and the dependence of the control voltage on the ratio of electrode width to crystal length is calculated. The electric field is assumed to be a steady and axisymmetric one, with a zero normal component at the entire crystal surface except under the electrodes. Calculations on the basis of the Laplace equation modified for an anisotropic medium and solved in the form of a series require an evaluation of coefficients in terms of the flux function and the deviation from exact boundary conditions. This deviation is orthogonal and to be minimized most effectively by the method of least squares, preferably using the cosine function. With the flux function and thus the potential distribution over the free crystal surface determined, as well as the charge on one electrode determined appropriately, the capacitance of a cylindrical modulator can then be calculated with the ratio of electrode width to crystal length as the adjustable design parameter. Figures 2; references: 1 Russian.  
[180-2415]

RADARS, RADIONAVIGATION AIDS,  
DIRECTION FINDING, GYROS

UDC 621.396.96

DECORRELATION OF THE ENVELOPE OF A RADAR SIGNAL REFLECTED BY A TARGET WITH  
SURFACE DISTRIBUTION AFTER INCIDENCE OF SIGNALS OF VARIOUS FREQUENCIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 1, Jan 81 pp 184-185  
manuscript received 11 Nov 79

POLYANSKIY, V. A.

[Abstract] The correlation between signals reflected by a target is known to be weaker in the case of transmitted signals of different frequencies than in the case of transmitted signals of the same frequency. Here a radar system is considered with a square-law detector and a target such as the sea surface. The decorrelating effect of changing the signal frequency on the envelope squared at the detector output, after backward reflection of the signal by the target surface, is evaluated without any constraints on the surface characteristics. Accordingly, the correlation coefficient is calculated for both cases. The irradiated segment of the target surface is treated as an array of  $N$  independent fluctuating scatterers, the radiation pattern of the antenna is assumed to be much less than 1 radian wide, and the duration of a radar pulse is assumed to be sufficiently long to make the signal at the target a cosinusoidal one. References 6: 4 Russian, 2 Western.  
[231-2415]

## RECORDERS

UDC 534.852.2(086.74)

### ANALYSIS OF THE PROCESS OF MAGNETIC RECORDING ON A RELATIVELY THIN CARRIER BY THE PREISACH METHOD

Moscow ELEKTRICHESTVO in Russian No 9, Sep880 pp 66-69 manuscript received 7 Sep 77

KOROLEV, Ye. F., Moscow

[Abstract] The head/carrier system is subject to wave and frequency losses during the recording and playback process which limit bandpass and cause deterioration in the signal-to-noise ratio. High frequencies (short waves) and their concomitant recording losses on thin carriers such as magnetic disks and metal taps have not been thoroughly studied. The recording process is nonlinear because of the nonlinear response of the magnetic carrier and the variability of the head's magnetic field. Statistical and phenomenological methods are applied to analyze the recording process based on the Preisach diagram. Amplitude, amplitude-frequency and phase response of recording wave losses are obtained. Amplitude-frequency response of the head/carrier system is derived in exponential power approximation. The present paper considers the algorithms of a simplified analysis on a digital computer of the process of magnetic recording of a sinusoidal signal without magnetizing the previously demagnetized thin carrier. Figures 6; references 12: 11 Russian, 1 Western.  
[75-8617]

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